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B0218+357: Time Delays and New MERLIN/VLA 5 GHz Maps of the Einstein Ring

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Abstract. This poster presents a new 5 GHz combined MERLIN/VLA map of B0218+357 which shows for the first time believable substructure in the Einstein ring. This will now be exploited for further constraints on the model which presently dominates the error on the estimate of H_0 derived from the time delay (10.5±0.4 days) measured for this system.

1. Introduction

Upon its discovery in 1992, the lens system B0218+357 (Fig. 1, left) was immediately recognised as an excellent candidate for determining H_0. The source is radio loud, highly polarised and variable and both redshifts are known. Modelling the mass responsible for the lensing is relatively simple compared to many other lenses as the deflector is believed to be an isolated face-on spiral galaxy. The Einstein ring is potentially a particularly useful source of modelling constraints as it effectively samples the lensing potential over many lines-of-sight (Kochanek 1990).

2. Time Delay Summary

The time delay has been measured to be 10.5±0.4 days at 95% confidence (Biggs et al. 1999) from VLA monitoring of total flux density and polarisation at two frequencies, 8.4 and 15 GHz. Although the time delay for this system is in little doubt, the above value has been independently confirmed (Cohen et al. 1999).

Modelling of this system is still at an early stage, but an initial Singular Isothermal Ellipsoid mass model constrained using the observed VLBI substructure of the two compact images and the flux density ratio found from the VLA monitoring, when combined with the above value of the time delay, gives an H_0 of $69^{+13}_{-19}\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$ (95% confidence).

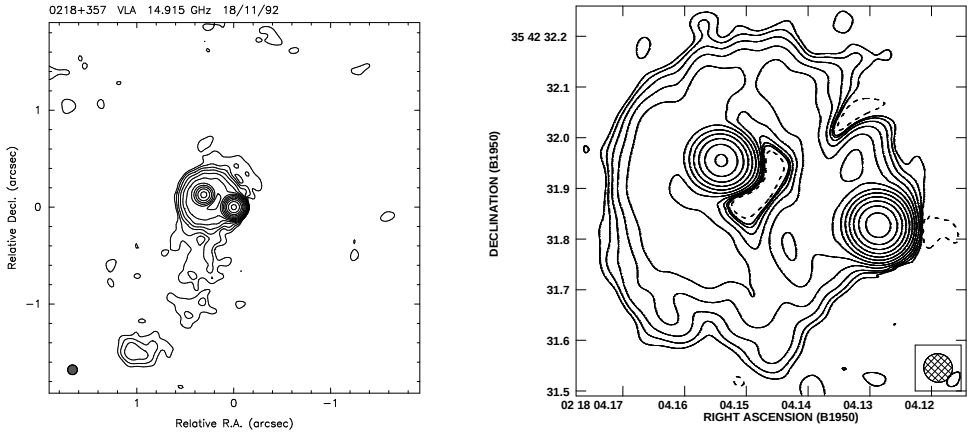

Figure 1. VLA 15 GHz map (left), MERLIN/VLA 5 GHz map (right).

3. MERLIN/VLA 5 GHz Map

To date, no models have exploited the Einstein ring for constraints on the lensing due to a lack of resolution and sensitivity in existing radio maps. A new image made from combined 5 GHz VLA/multi-frequency synthesis MERLIN data is shown in Fig. 1 (right). The MERLIN data give high resolution ($\sim$50 mas) whilst the many short baselines of the VLA provide much more sensitivity and aperture coverage for detecting and mapping the extended ring emission.

The most prominent feature revealed by the new map is the hole in the centre of the ring, a hint of which is also seen in the 15 GHz VLA image. The MERLIN 5 GHz map also shows valleys of reduced surface brightness stretching away north and south from the hole that make the ring's morphology more akin to that of two arcs. Each of these is further separated into several discrete areas of increased brightness. Work is at present underway to exploit this new image for extra modelling constraints.

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